

"Made available under NASA sponsorship
in the interest of early and wide dis-
semination of Earth Resources Survey
Program information and without liability
for any use made thereof."

E7.3 109.34
CTR-133605

APPLICATION OF ECOLOGICAL, GEOLOGICAL
AND OCEANOGRAPHIC ERTS-1 IMAGERY
TO DELAWARE'S COASTAL RESOURCES
PLANNING

V. Klemas
College of Marine Studies
University of Delaware
UN 362 SR 9654

September 5, 1973
Type I Progress Report
for period July - August 1973

Prepared for
GODDARD SPACE FLIGHT CENTER
GREENBELT, MD 20771

E73-10934) APPLICATION OF ECOLOGICAL
GEOLOGICAL AND OCEANOGRAPHIC ERTS-1
IMAGERY TO DELAWARE'S COASTAL RESOURCES
PLANNING Progress Report, Jul. - Aug.
(Delaware Univ.) 7 p HC \$3.00 CSCL 08C

N73-30276

Unclass
00934

G3/13

Analysis of digital ERTS data appears to provide considerably more accurate and detailed results than analysis of ERTS images due to the increased quality of the data stored in digital form. The analysis techniques developed by Bendix are well suited to data in this form.

C. Significant Results

Significant results obtained by analysis of digital ERTS data are as follows:

1. Statistical outputs indicating the reliability of discriminating eight coastal vegetation and land use classes based on a given group of training sets included:

- a. Mean and standard deviation of response in each class chosen.
- b. Contribution tables indicating importance of each channel in discriminating each thematic class from the background.
- c. Scatter diagrams showing relationships of thematic spectral signatures in spectral space.
- d. Classification table showing reliability (in percent) of identification of each thematic class.

2. Thematic color maps at a scale of 1:1,000,000 showing vegetation and land use categories outlined in section B for Delaware's entire coastal zone.

3. Thematic computer plots at specified smaller scales (i.e. 1:24,000) for comparison with existing map data (i.e. U.S.G.S. topographic maps).

2

A. Problems

Delivery of ERTS-1 digital tapes is too slow. This delay causes our digital analysis to lag 3 months behind the optical analysis of imagery. Telephone calls have been made to speed up the delivery of new tapes.

B. Accomplishments

Special emphasis has been placed on analysis of ERTS digital tapes using techniques and equipment developed by Bendix Aerospace Systems Division of Ann Arbor, Michigan. A University of Delaware researcher spent one week at the Bendix facility during which time training sets were established for eight vegetation and land use classes based on data contained in ERTS scene 1079-15133 recorded on October 10, 1972. Classes selected were:

1. Phragmites communis (Giant Reed Grass)
2. Spartina alterniflora (Salt Marsh Cord Grass)
3. Spartina patens (Salt Marsh Hay)
4. Forest
5. Dredge-fill and bare sand
6. Shallow water and bare mud
7. Deep water (< 3m.)
8. Agriculture (combination of several spectral signature)

Statistical analysis performed by the Bendix computer showed that discrimination of classes 2, 4, 5, 6, and 7 was excellent (greater than 90% reliability) while identification of classes 1, 3 and 8 was somewhat less reliable. It is believed that refinement of training sets for these categories will eliminate these problems.

D. List of Publications

1. Szekiolda, K. H., Kupferman, S. L., Klemas, V., Polis, D. F., Element Enrichment in Organic Films and Foam Associated with Aquatic Frontal Systems, Journal of Geophysical Research, Volume 77, No. 27, September 20, 1972.
2. Klemas, V., Use of Remote Sensing to Determine Natural and Man-Made Changes in the Coastal Zone, Delaware Academy of Sciences Annual Meeting, Dover, November 16, 1972.
3. Klemas, V., Srna, R., and Treasure, W., Investigation of Coastal Processes Using ERTS-1 Satellite Imagery, American Geophysical Union Annual Fall Meeting, San Francisco, California, December 4-7, 1972.
4. Klemas, V., Daiber, F., Bartlett, D., Crichton, O., Fornes, A., Application of Automated Multispectral Analysis to Delaware's Coastal Vegetation Mapping, American Society of Photogrammetry Annual Meeting, Washington, D. C., March 11-16, 1972.
5. Klemas, V., Daiber, F., Bartlett, D., Identification of Coastal Vegetation Species in ERTS-1 Imagery NASA ERTS-1 Symposium on Significant Results, Washington, D. C., March 5-9, 1973.
6. Klemas, V., Treasure, W., and Srna, R., Applicability of ERTS-1 Imagery to the Study of Suspended Sediment and Aquatic Fronts. NASA ERTS-1 Symposium on Significant Results, Washington, D.C., March 5-9, 1973.
7. Kupferman, S., Klemas, V., Polis, D., and Szekiolda, K., Dynamics of Aquatic Frontal Systems in Delaware Bay, A. G. U. Meeting, Washington, D. C., April 16-20, 1973.
8. Klemas, V., Srna, R., Treasure, W., Assessment of Sediment Dispersal Patterns on Delaware Bay by use of ERTS-1 Satellite Imagery, International Symp. on Interrelationships of Estuarine and Continental Shelf Sedimentation, Bordeaux, France, July 9-14, 1973.
9. Klemas, V., Srna, R., Treasure, W., and Conrod, A., Satellite and Aircraft Studies of Suspended Matter and Aquatic Interfaces in Delaware Bay, A.S.P. Symposium on Remote Sensing in Oceanography, Orlando, Florida, October 2-5, 1973.
10. Klemas, V., Bartlett, D., Daiber, F., Mapping Delaware's Coastal Vegetation and Land Use from Aircraft and Satellites A.S.P. Symposium on Remote Sensing in Oceanography, Orlando, Florida, October 2-5, 1973.
11. Klemas, V. (Invited Paper) Application of the ERTS-1 Satellite to Coastal Environment Studies, Second Conference on Environmental Quality Sensors, National Environmental Research Center, Las Vegas, Nevada, October 10, 1973. (Sponsor-EPA).

1 4

F. Conformance to Schedule

Measured from the date of ERTS-1 imagery delivery, we are on schedule.

F. Work Progress Evaluation

The significant results obtained by analysing the digital tapes for coastal land use and vegetation have exceeded our expectations. At least two significant papers will be published on that subject.

G. Adequacy of Funds

Additional funding will be required to accomplish new task defined during the last program review, i.e. the installation and maintenance of data collection platforms in Delaware Bay. A proposal for the extended work is being prepared.

H. Personnel Changes

None

I. Future Planned Work

1. To further correlate suspended sediment properties measured from boats with microdensitometry traces of ERTS-1 images and digital tapes.
2. To monitor and correlate with satellite imagery water temperature, salinity, dissolved oxygen, acidity, turbidity, currents and winds with ERTS data collection platforms to be installed in Delaware Bay.
3. To extend the wetlands vegetation mapping performed using ERTS-1 to include data on the reliability of identifying various marsh species and land use signatures.
4. To study dynamic conditions at proposed off-shore sludge disposal sites by using ERTS-1 data and dye-drops.
5. To correlate five major pollution plumes studied from boats in the Delaware River with aircraft and ERTS-1 imagery, and digital tapes.
6. Bendix Corporation will support all these efforts by analysing ERTS-1 digital tapes and preparing thematic maps based on our ground truth.
7. To publish two more articles in scientific journals and present three more papers at national and international meetings. A list of publications is shown in one of the previous sections.

5

IMAGERY FROM
ERIS-1 SATELLITE OVERPASSES*
OF DELAWARE BAY REGION

<u>Date of Pass</u>	<u>Region</u>	<u>I. D. Number</u>	<u>Bands</u>	<u>Quality</u>
8/18/72	DO	1024-15073	M	B
9/3/72	DO	1024-15074	M	B
9/22/72	DB	1061-15132	M	C
10/9/72	DB	1078-15075	M	B
10/10/72	DO	1079-15133	M	A
10/27/72	DO	1096-15083	M	B
12/2/72	DO	1132-15083	M	C
12/3/72	DB	1133-15141	5,6,7	A
1/26/73	DB	1137-15140	M	A
2/13/73	DB	1205-15141	M	A
3/2/73	DO	1222-15084	M	C
3/20/73	DO	1240-15085	M	B
4/7/73	DO	1258-15085	Mq	B
6/1/73	DB	1313-15141	M	C
7/7/73	DB	1349-15134	M	B
7/24/73	DB	1366-15074	5,6,7	B
8/29/73	DO		M	A

Bands M = 4, 5, 6, 7

Band 4 = 0.5 - 0.6 microns
 Band 5 = 0.6 - 0.7 microns
 Band 6 = 0.7 - 0.8 microns
 Band 7 = 0.8 - 1.1 microns

Format M = 70 mm negative

S = 70 mm positive transparency
 T = 9.5 in positive transparency
 P = 9.5 in paper print
 9 = 9-track tape 800 (bpi)

Region DB = Delaware Bay
 DO = Delmarva Coast

*This list shows imagery containing less than 60% cloud cover only.

NASA ERTS AND SKYLAB AIRCRAFT OVERFLIGHTS
OF DELAWARE BAY TEST SITE

<u>DATE</u>	<u>AIRCRAFT AND ALTITUDE</u>	
September 14, 1970	RB-57 at 60,000 ft. altitude	(NASA-Houston)
November 4, 1971	U-2 at 65,000 ft. altitude	(NASA-Ames)
August 26, 1971	C-54 at 11,500 ft.	(NASA-Wallops)
September 15, 1972	U-2 at 65,000 ft. altitude	(NASA-Ames)
October 27, 1972	C-130 at 10,000 ft. altitude	(NASA-Houston)
December 3, 1972	U-2 at 65,000 ft. altitude	(NASA-Ames)
March 24, 1973	U-2 at 65,000 ft. altitude	(NASA-Ames)
April 5, 1973	C-130 at 10,000 ft.	(NASA-Houston)
May 14, 1973	C-130 at 10,000 ft.	(NASA-Houston)
April, 1973 - November, 1973	Sidelooking Radar Overflights	(NASA-Wallops-Navy)
June 1, 1973	C-54 at 11,500 ft.	(NASA-Wallops)
August 17, 1973	Laser Wave Profiling Overflights	(NASA-Wallops-Navy)
August 23, 1973	Laser Chlorophyll and Oil Detection Overflights	(NASA-Wallops)
August 29, 1973	C-130 at 3,000 to 25,000 ft.	(NASA-Houston)

*This list does not include helicopters provided for water sampling during ERTS-1 overpasses, nor small aircraft used by the University of Delaware for low altitude photographic overflights.